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A Capacitive Transducer Receiver

By William Simes

When first introduced to electrostatics, we learn that like charges repel while unlike charges attract. This being the case, it follows that when a dc voltage is applied to a parallel plate capacitor, one plate becomes charged positively and the other is charged negatively. Then according to Coulomb's law, there must be a force tending to pull the two plates together. If the polarity of the applied voltage is reversed, a force of equal magnitude still tends to pull the plates together. For a given capacity then, the force of attraction between the plates might reasonably be expected to be a function only of voltage magnitude completely independent of the polarity.

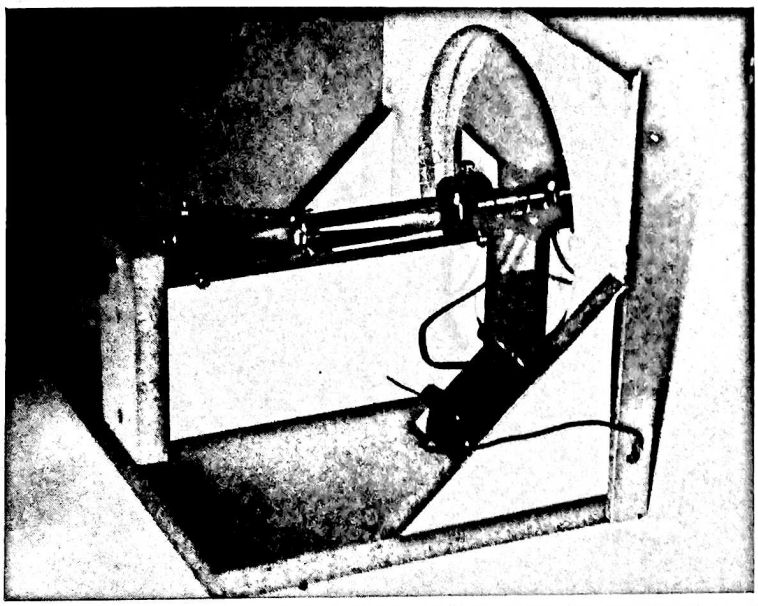

Photo 1: Bill's capacitive transducer

Now suppose the charging voltage source is alternating, moreover, it is alternating at radio frequency. If the amplitude of this voltage remains constant, the mechanical inertia of the metal plates might well integrate the rapidly changing force into a steady state force. What would happen then if instead of maintaining a constant amplitude, the amplitude of this applied RF voltage were modulated at an audio rate? Would not the plates attract one another (move toward and away from each other) at the modulated audio rate? What if now, one plate were stationary with a relatively high mass while the other was merely a thin conductive diaphragm of relatively low density? Would not such an arrangement serve as a sound transducer for the modulating audio? These are questions that come to mind. If the reasoning is sound (no pun intended) it should be possible to devise a variable capacitive transducer allowing the entire AM wave train to be received without using a rectifying detector that discards half of the received signal to recover the modulating information. In pursuit of the theory, I assumed some physical dimensions within the whittling capabilities of my shop and did some cursory arithmetic. The results weren't promising, but I built an experimental model anyway. The completed circuit for an AM receiver using the capacitive transducer is shown in Fig. 1. Circuit wise, this may well be the simplest receiver yet! A functional diagram of the transducer is shown in Fig. 2.

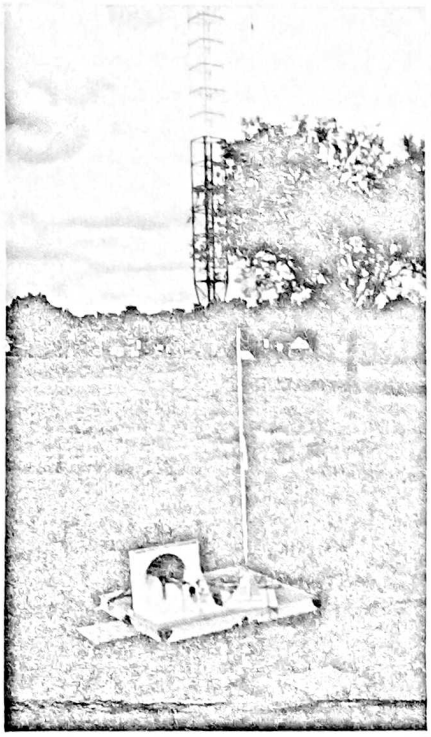

Photo 2: Testing the transducer behind the local AM station.

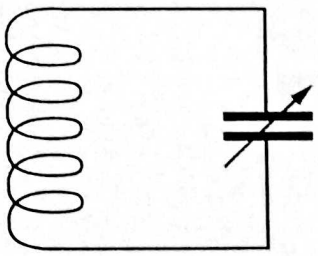

Figure 1: Circuit of the capacitive transducer

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Thinking it would be less embarrassing if there were no witnesses to an experiment with probable failure, I loaded the transducer, a loop antenna and a portable picnic table in the car and set out alone to test my theory. I parked the car to the side of a lightly traveled road near a local broadcast station antenna. At a distance about equal to the radius of the tower guy wire anchors, I set up shop and slowly tuned the transducer. Much to my surprise the signal was there! Fidelity was good and clear. Tuning, however, was critical.. so critical in fact that thermal distortions from the hot sun made it necessary to retune frequently.

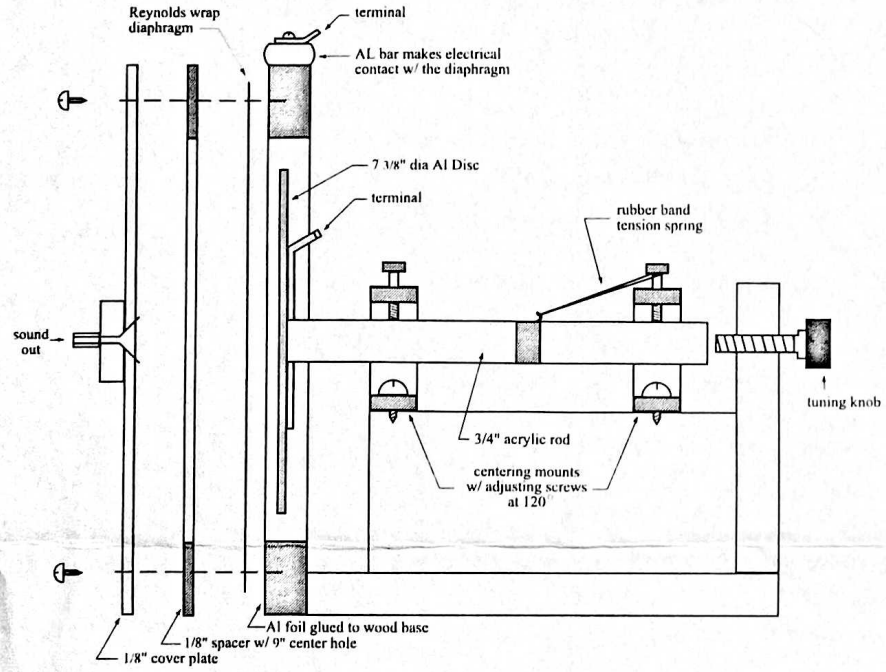

Figure 2: Functional diagram of the capacitive transducer.

Elated with the test results, I packed up, drove home, and returned with my wife, Elaine, and a camera to repeat the experiment; this time I had a witness and a means to photographically document the event. The good news from this exercise is that the device functions as planned, responding faithfully to both positive and negative excursions of the modulated carrier while using neither a rectifying detector nor conventional headphones. Circuit-wise it's hard to imagine a simpler receiver. The bad news is that you have to be close to the broadcast tower to receive the signal. From home, 3 miles from the tower, I heard nothing. I didn't try it at distances in between. Clearly, the device is not yet a DX machine and there is room for much improvement. I tried replacing the Reynolds wrap aluminum diaphragm with metalized Monokote. It's a heat-shrink plastic film for covering model airplanes. It creates a beautiful, mirror-like diaphragm. It works as a tuning capacitor, as evidenced by strong reception when I hooked up a diode and phones. As a transducer, however, it was a complete bust, so, it's back to Reynolds Wrap.

GRID LEAK DETECTOR ONE TUBE RADIO

By John M. Franke, WA4WDL

As you suggested in several issues of your publication, perhaps it is time to expand the coverage to include simple vacuum tube radios. Having an aversion to regenerative receivers, I decided to try a simple grid leak detector. Besides, grid leak detectors predate regenerative and superregenerative detectors. I chose a 1G4 GT/G triode for several reasons. First, I have a half dozen of them. Second, they have a directly heated cathode requiring only 50 milliamps at 1.4 volts filament power. Almost any triode could be used. But, in keeping with the spirit of antique radio, directly heated cathodes should be preferred. Several suggested tubes would be the old 5 volt '01A and for 2 volt filaments, a type 30 or a type 1H4. Don't overlook the use of 7 pin, miniature 1.5 volt tubes formerly used for portable battery powered radios. Ideally, a tube having a low amplification factor but high transconductance is most desirable.

Whatever tube you select, make sure you can find a socket for it. Sockets are becoming almost as hard to find as are the vacuum tubes to go in them. This is especially true for the large odd sockets needed for transmitting tubes. Fortunately, the 1G4 GT/G uses a common octal socket. I prefer molded sockets over phenolic wafer sockets because of their superior durability. Ceramic sockets are the most appealing but hardest to find. I was lucky and found a special relay socket that has an octal socket and eight screw terminals all molded together in one piece. The screw terminals permit changes to be easily made. I do not even have to turn the socket over to get at each pin. It is ideal for bread boarding low frequency vacuum tube circuits.

For my first attempt at using a grid leak detector, I decided to use the same center tapped-tuned circuit that I used to test crystal detectors. The complete schematic is shown in Figure 3. The tuning capacitor is a dual section 25-620 micromicrofarad variable. The coil is a surplus tapped air core coil that happens to tune the A.M. broadcast band. A second set up was tried with a link coupled input-tuned circuit. Since I use a high impedance antique magnetic speaker with the crystal sets, I used the same speaker as a load for the grid leak detector. Performance improvement or lack thereof can be determined by measuring the a.c. audio signal across the speaker winding. I did try an output transformer and regular 8 ohm dynamic speaker, which is not as efficient as the old magnetic speaker but nevertheless

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